per cent. of the force of gravity upon it; and electric forces of not very dissimilar magnitudes must have acted on the air electrified as it actually was in the non-spherical enclosure used in our experiments. If natural air or cloud, close to the ground or in the lower regions of the earth's atmosphere, is ever, as in all probability it often is, electrified to as great a degree of electric density as we have found it within our experimental vat, the natural electrostatic force in the atmosphere, due as it is, no doubt, to positive electricity in very high regions, must exercise an important ponderomotive force quite comparable in magnitude with that due to difference of temperatures in different positions.

It is interesting to remark that negatively electrified air over negatively electrified ground, and with non-electrified air above it, in an absolute calm, would be in unstable equilibrium; and the negatively electrified air would therefore rise, probably in large masses, through the non-electrified air up to the higher regions, where the positive electrification is supposed to reside. Even with no stronger electrification than that which we have had within our experimental vat, the moving forces would be sufficient to produce instability comparable with that of air warmed by the ground and rising through colder air above.

§ 15. During a thunderstorm the electrification of air, or of air and the watery spherules constituting cloud, need not be enormously stronger than that found in our experiments. This we see by considering that if a uniformly electrified globe of a metre diameter produces a difference of potential of 38 volts between its surface and centre, a globe of a kilometre diameter, electrified to the same electric density, reckoned according to the total electricity in any small volume (electricity of air and of spherules of water, if there are any in it), would produce a difference of potential of 38 million volts between its surface and centre. In a thunderstorm, flashes of lightning show us differences of potentials of millions of volts, but not perhaps of many times 38 million volts, between places of the atmosphere distant from one another by half a kilometre.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Council of the Owens College has, on the recommendation of the Senate, made the following appointments to Fellowships in the College:—Bishop Berkeley—Dr. A. W. Crossley in Chemistry, A. H. Jameson in Engineering; Honorary Research—Wilmot Holt, junr., in Chemistry.

MR. ANDREW J. HERBERTSON, of Edinburgh, has been appointed Lecturer on Geography at the Owens College, Manchester, in succession to Mr. Yule Oldham.

SCIENTIFIC SERIALS.

American Journal of Mathematics, vol. xvi. 3. (Baltimore: July 1894.)—A class of uniform transcendental functions, by Dr. T. Craig (pp. 207-220), gives another mode of forming a certain transcendental function first introduced by M. Picard (*Comptes Rendus*, 1878), and which does not seem to have been subsequently discussed. M. G. Humbert (pp. 221-253), writing "Sur les surfaces de Kummer elliptiques," after mentioning that Cayley's *tetrahedroid* is a particular case of a Kummer surface with six double points, applies himself to the problem of determining whether any other of these surfaces possess similar properties.—Mr. Basset contributes a memoir on the deformation of thin elastic plates and shells (pp. 254-290). The origin of the investigation appears to be the dissatisfaction Mr. Basset has felt with Mr. Love's treatment of the theories of thin plates, shells, and wires in the second volume of his book on "Elasticity."

Jahrbuch der k. k. geolog. Reichsanstalt Wien. Bd. xliii. Heft 3 and 4, March 1894.—Although Graz is one of the few localities in the Central Alps in which palæozoic strata are present containing good fossils, the exact age of these strata and their parallelism with the Silurian and Devonian strata of extra-Alpine regions have remained uncertain. The richly fossiliferous Coral-limestone of the Graz succession was determined as mid-Devonian by Suess, Stache, and others. Hoernes, on the other hand, thought it Lower Devonian. Now, for the first time, the Corals have been made the subject of a detailed study.—Dr. K. A. Penecke contributes a paper to the *Jahrbuch*, "On the Devonian strata of Graz," in which he proves that the "Coral limestone" and the "Calceola horizon" immediately above it are the uppermost bed of the *Lower Devonian* series. The age of the palæozoic strata of Graz ranges, according to Dr. Penecke, from the oldest Silurian to the youngest Devonian, and may possibly include a part of the Lower Coal Measures.—The monograph of the Raibl strata, by Baron von Wöhrmann, marks a considerable advance in our knowledge of Alpine Trias. The author's previous papers on the Raibl fauna in North and South Tyrol, have paved the way for this general paper. All the Raibl facies known in the Alps are described, the species contained in them reviewed, the indications of the geographical conditions discussed, and comparative references made to extra-Alpine seas in the same period. The subject is one of the most complex, but its treatment is searching, concise, and exhaustive. We note, almost with relief, the entire absence of the speculative method and wordy argument too frequently seen of late in matters concerning the Alps.

Bd xliv. Heft 2, June 1894.—"On the newer literature of the Alpine Trias," by Dr. A. Bittner. The personal and polemical tone of this paper renders it somewhat remarkable. By way of reviewing the terminology and literature of the Alpine Trias, Dr. Bittner exposes scathingly the fashion of new name-giving on insufficient grounds, the prejudice and obstinacy with which a name once given is apt to be retained, and the danger to science of subsequent attempts to modify the original meaning of a name, and prop a deservedly falling fabric. The writings of Mojsisovics are those which specially come under the whip. We are told, for example, that in studying "the Cephalopoda of the Hallstadt Limestone," one of the greatest works of Mojsisovics, we must read everywhere—instead of Mediterranean Trias, Alpine Trias; instead of Juvavic horizon, Noric horizon; instead of Noric horizon, Ladinian horizon; the author of the work himself having entirely departed from the geological conceptions for which the names were created! Dr. Bittner's paper is, to say the least, breezy; but, on the principle of the old proverb, "It's an ill wind, &c.," there is no doubt it will have a healthful effect in blowing away some of the cobwebs of tradition from a study which nature had already made so difficult and so fascinating.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 10.—"The Composition of Atmospheres which Extinguish Flame." By Dr. Frank Clowes, Professor of Chemistry, University College, Nottingham.

The statements usually published, as to the proportion of carbon dioxide in air necessary to extinguish a candle flame, vary widely. The present investigation was undertaken with the object of fixing the minimum proportion of carbon dioxide and of nitrogen gas, which, when mingled with air, will extinguish flame; and with the further object of ascertaining also the minimum proportion of each of these gases, which is necessary to extinguish the flames of different combustible substances, including those of certain gases.

The method of experimenting, which was devised, prevented the introduction of errors arising from the incomplete mixture of the gas with the air, from the solubility of carbon dioxide in water, and from the effect of carbonic dioxide produced from the flame during its combustion. The proportions of gas and air in the mixtures used were checked by analysis and were shown to be accurate, and duplicate experiments agreed in their results closely.

A preliminary series of experiments proved that, within the wide limits selected, the extinctive proportion of carbon dioxide was independent of the *size* of the flame of any particular combustible which was introduced into the mixture.

An extended series of experiments was then made to ascertain the minimum extinctive proportion of carbon dioxide for flames of very various description. The results arrived at showed that the flames of very different combustibles which were burnt from wicks, required a strikingly similar proportion of carbon dioxide in the air for their extinction. Thus the percentage of carbon dioxide necessary for the extinction of the flames of the following combustibles were: for absolute alcohol, 14; for methylated alcohol, 13; for paraffin oil, 15; for mixed colza and petroleum, 16; and for a candle, 14.

The extinctive proportions of the gas for the flames of various gases burnt from a jet, on the other hand, showed wide differences. The minimum percentages of carbon dioxide gas in air required for the extinction of the various flames of gases were as follows: for hydrogen, 58; for carbon monoxide, 24; methane, 10; ethylene, 26; and for coal-gas, 33. These numbers show no relation, as they might have been expected to do, to the volume of oxygen necessary for the combustion of the different gases.

A second series of experiments was then undertaken to ascertain the minimum proportion of nitrogen which must be added to the air in order to render it extinctive of the various flames already specified. It was found necessary in every case to add nitrogen in larger proportion than carbon dioxide to the air, in order to secure the extinction of a flame. The superior extinctive power of carbon dioxide over that of nitrogen is probably connected with its higher specific heat, and with its greater density.

Characteristic differences were noticed between the behaviour of wick-fed flames and flames supplied with gas from a jet, during the process of their extinction. The wick-fed flame gradually *diminished* in size until it ultimately dwindled away. The gas-fed flame, on the other hand, rapidly *increased* in dimensions, at the same time becoming more and more pale; and it became so pale at last as to be often visible with difficulty, so that it was not easy to mark the moment of its extinction. Probably the extinction of both classes of flames was primarily due to the lowering of their temperatures. In the case of the wick-fed flames, however, the reduction of their temperature led to the diminution of the supply of gaseous and vapourous fuel to the flame, and the flame ultimately died because it was starved. In the case of gas-fed flame the supply of fuel, being independent of the flame, was maintained, and the flame perished from lowering of temperature only; in its effort to obtain an adequate supply of oxygen in the diluted air, however, it expanded its surface, and it thus undoubtedly hastened the reduction of temperature which led to its extinction.

The very high proportion of carbon dioxide in air which is necessary for the extinction of the hydrogen flame has received an important and interesting application. One of the most serious troubles to which the miner is exposed when using his safety-lamp, is the extinction of its flame by air containing carbon dioxide. In most mines the lamp cannot be relighted with safety, since a naked flame would cause danger in the possible presence of inflammable gas. The loss of the flame therefore implies the necessity of the miner moving in darkness often through a considerable distance to a place where the wick may be relighted without risk. The safety-lamp for delicate and accurate gas-testing, which has been already described by the author (*Roy. Soc. Proc.* vol. lii. p. 486), provides the means of avoiding this inconvenience and possible danger. Without opening this lamp it can be made to burn either an ordinary oil-flame alone, or a hydrogen flame alone, or both these flames may be made to burn side by side. If the miner is approaching a part of the mine in which the proportion of carbon dioxide may be extinctive of his oil-flame, he would turn on the hydrogen-flame as an auxiliary. If the oil-flame becomes extinguished, he has proof that he has entered air containing at least fifteen per cent. of carbon dioxide; but he can withdraw from it with his hydrogen-flame still burning, and in purer air the hydrogen-flame will at once rekindle the wick and give him his illuminating flame once more. Under certain circumstances he might even with safety pass though the foul air, and in a similar way regain his oil-flame. It is even possible to arrange the hydrogen-jet so close to the wick, that the oil-flame is more or less perfectly maintained by the hydrogen-flame even in the presence of much carbon dioxide.

The question has been raised whether it is safe to enter air which contains sufficient carbon dioxide to extinguish a candle-flame. This question is usually answered in the negative. But recent experiments made by J. R. Wilson (*Amer. Journ. Pharm.* 50, No. 12), seem to prove that rabbits can breathe for an hour with entire immunity from harm or even discomfort air containing 25 per cent. of admixed carbon dioxide, and that when the air contains 50 per cent. of the gas it is by no means immediately fatal to a rabbit which is immersed in it. Now air containing 15 per cent. of carbon dioxide at once extinguishes an ordinary candle-flame or oil-flame. Hence it appears that air may contain a considerably larger proportion of carbon dioxide than that which is necessary to extinguish the flame of a lamp or candle, and yet be competent to maintain life when it is breathed. This statement is fully supported by experiments made by Dr. Angus Smith, as well as by the experience of miners and others.

The following conclusions may be drawn from the experiments referred to above:—

(1) That the extinction of a flame depends not only upon the *quantity* but also upon the *quality* of the extinctive gas present in the air; carbon dioxide uniformly exerting a more powerfully extinctive effect than nitrogen.

(2) That wick-fed flames burning different combustibles show a remarkable uniformity in the minimum proportion of an extinctive gas in air necessary for their extinction.

(3) That this uniformity is not shown by flames fed by a gas burning from a jet; and no simple relation is apparent in the case of the gas-fed flames between the proportion of oxygen present in the diluted air and the proportion of oxygen requisite for the complete combustion of the gas.

(4) That the hydrogen flame requires for its extinction the presence in air of a very high proportion of extinctive gas; it may therefore be advantageously used as an auxiliary flame for maintaining an oil-flame in the foul air of a mine or other locality.

(5) Since an ordinary candle-flame or oil-flame is extinguished by the presence of about 15 per cent. of carbon dioxide in air, and air containing over 25 per cent. of carbon dioxide has been breathed with perfect safety for more than an hour, the extinction of an ordinary oil- or candle-flame in any particular atmosphere must not be taken as proof that that atmosphere contains so much carbon dioxide as to be dangerous to life when it is breathed.

(6) A more satisfactory indication of the presence of a dangerous proportion of carbon dioxide is furnished by the change of colour of the hydrogen flame from reddish to blue-grey. This change begins when 2 per cent. of carbon dioxide is present in the air; it becomes very pronounced as the proportion of the gas present increases. When 30 per cent. or upwards is present the flame is of a pronounced blue colour and also increases in height with the increased proportion of the gas, to an extent which is easily measured on a scale.

May 31.—"Note on the Possibility of obtaining a Unidirectional Current to Earth from the Mains of an Alternating Current System." By Major P. Cardew.

June 21.—"Degenerations consequent on Experimental Lesions of the Cerebellum." By Dr. J. S. Risien Russell.

The paths which degenerate after ablation of one lateral lobe of the cerebellum, and after extirpation of its middle lobe, are discussed in this paper.

Degenerated fibres are found in all the peduncles on the same side after the former operation, and in the superior peduncle of the opposite side. The position occupied by these degenerated fibres, in this peduncle, is that of fibres which degenerate in both superior peduncles after the cerebellum has been divided into two lateral halves by a mesial incision. The degenerated fibres in the superior peduncle of the side of the lesion decussate in the posterior quadrigeminal region, and pass to the opposite red nucleus and optic thalamus. Those fibres which degenerate in the middle peduncle pass chiefly to the grey matter of the opposite side of the pons. Of the fibres which degenerate in the inferior peduncle, the majority occupy the lateral region of the medulla, becoming more and more scattered as they pass down. These can no longer be said to form a tract below the level of the superior pyramidal decussation; but a few scattered fibres occupy the antero-lateral region of the cervical cord, beyond which none can be traced. Degenerated fibres pass to both inferior olives from this peduncle; but no well-marked tract to the opposite inferior olive was found.

After extirpation of the middle lobe of the cerebellum, degenerated fibres were found in all the peduncles. Those in the superior peduncle decussate in the region of the posterior corpora quadrigemina, and terminate in the opposite red nucleus. The degenerated fibres in the middle peduncle behave much as do those which result from ablation of one lateral lobe of the cerebellum; and the same may be said with regard to the degenerated fibres in the inferior peduncle.

No degeneration was found in the fillet, posterior longitudinal bundles, pyramids, ascending root of the fifth nerve, the roots of the cranial and spinal nerves, and in the spinal cord, forming an antero-lateral tract throughout its whole length.

Physical Society, June 22.—Prof. W. E. Ayrton, F.R.S., Past-President, in the chair.—Captain Abney, before exhibiting his photographs of flames, demonstrated that a candle flame contains solid particles by passing a beam of polarised light though it, the track of the beam through the flame being clearly seen in one direction, whilst in a direction at right angles it was practically invisible. The same thing was also shown by passing the light through a turbid liquid. Photographs of argand and candle flames with pencils of sunlight and electric light passing through, were then exhibited showing similar phenomena. Several series of photographs of flames of candles and various forms of gas-burner taken with diminishing exposures were then shown in order to illustrate the different luminosities at different parts of the flame. Those taken with long exposures showed the bright parts nearly equally white, but as the time of exposure diminished only the most luminous portions were recorded on the plate. From the photographs the author concluded that when used with a slit as a photometric standard the argand burner was unsuitable, for portions of different luminosity come into view when the slit is approached or receded from. The ordinary fish-tail burner was better in this respect. Questions were asked and remarks made by Prof. S. P. Thompson, Prof. Perry, and Mr. Trotter, in reply to which Captain Abney said dropped shutters with slits from one inch to one-sixteenth inch wide had been employed, and some of the exposures were only a few thousandths of a second. The displacement caused when the object was not stationary could easily be allowed for when the velocity of the shutter was known.—Prof. O. Henrici read a paper on an elementary theory of planimeters. Considering the generation of areas by the motion of straight lines, the author defined the sense in which such areas are to be taken. Choosing the positive sense of a line O T of variable length as outwards from the centre O about which it turns, and the positive direction of rotation as counter-clockwise, the following rule for determining the sense of an area was given. Imagine yourself standing at a point P, and looking along the positive sense of O T, whilst it passes over P, then the area near P will be swept out in *a positive sense if O T crosses you from right to left*, otherwise it will be negative. Applying this rule to closed curves of any shape, it was shown that if T goes once round the boundary, any area outside the curve was necessarily swept over as many times in the negative sense as in the positive sense, therefore these areas cancelled, and also that the sense of any part of an area depends on the sense of its boundary. Passing on to the consideration of areas generated by a line (or rod) of fixed length, which moves anyhow in a plane and returns to its initial position, Prof. Henrici showed by taking instantaneous centres, that the same rule regarding the sense of the areas holds, and that the area generated by the rod is equal to the difference between the areas of the two closed curves traced by its ends. In the particular case where one end of the rod moves forwards and backwards along the same path the area swept out by the rod is equal to that of the closed curve traversed by the other end. This is the theory of Amsler's planimeter, for the area of the curve whose boundary is traversed by the tracer is the same as that swept out by the rod carrying the tracer when the pole is outside the closed curve. By resolving small motions of the rod in two component parts, a translation parallel to itself, and a rotation about the point in which the plane of the registering wheel cuts the rod, the author showed that the areas swept out by the translations were registered by the wheel, whilst the sum of those generated during the rotations cancel. Cases where the pole is inside the curve were next considered, and the constant then to be added to the wheel reading determined. Instead of registering the translation by a wheel whose axis is parallel to the rod, a knife-edged wheel which slides and turns freely on an arm perpendicular to the rod would serve the same purpose. This is the principle of Hine and Robertson's planimeter. In the actual instrument, however, the arm is inclined at about 10° to the rod, and is therefore inaccurate. In the "hatchet" planimeter a bent rod terminates at one end in a tracing point, and at the other in a convex knife-edge or "keel," whose plane contains the point. The area of the curve whose boundary is traversed by the point is approximately equal to twice that of the sector included between the initial and final positions of the rod. The approximation results from the fact that the area of the curve traced by the keel is not zero. At the meeting the question of reducing the area of the keel curve was discussed at some length, the author showing that in the case of a curve symmetrical about a line, it was possible to reduce this area practically to zero. Even for unsymmetrical curves one could obtain a symmetrical one of double the area by drawing a line, cutting the curve, and supposing the area turned over about this line. Prof. Perry inquired if the author's conclusion was that the "hatchet" planimeter and the Hine and Robertson instrument were inaccurate? If so, he was at a loss to understand why the latter gave results more nearly correct than Amsler's. Mr. Blakesley pointed out that if both arms of a jointed planimeter be simultaneously moved over curves the total reading should give the sum of the two areas traced out if taken in the proper senses. Mr. A. P. Trotter directed attention to an article by the inventor of the "hatchet" in the current number of *Engineering*. Dr. Macfarlane Gray said he had examined the proof given in *Engineering*, and found no error. He then showed how the Amsler planimeter could be explained in a simple geometrical manner by drawing radial lines through the pole and intersecting the curve. Moving the tracer along these radii added nothing to the area; motion along the arcs was the important component. Mr. O. G. Jones and Prof. Thompson also took part in the discussion.—Mr. F. W. Hill made a communication on the "hatchet" planimeter. In this paper the author takes a point within the area to be measured, and divides the area into elementary triangles with this point as apex. The tracing point of the planimeter is then supposed to start from the apex and trace out one of the triangles. The inclination between the initial and final positions of the "hatchet" is then expressed in terms of the angle at the apex, the radius vector, and the length of the planimeter. By expanding and integrating the expression, it is shown that twice the area between the initial and final position of the planimeter, after tracing all the triangles, is represented by an infinite series of terms, the first of which is the area of the curve, the second is proportional to the moment of inertia of the area about the point, the third proportional to its first moment about the same point. The higher terms are usually small enough to be neglected. Starting the tracer at the centroid of the area causes the third term to disappear, and the second has its minimum value, so that this is the starting-point recommended. The magnitude of the errors caused by neglecting the various terms are discussed in some detail. In the author's opinion, the instrument can never be strictly accurate; but usually the errors are within the limits of observation. Prof. Henrici did not agree with the statement that the instrument was necessarily inaccurate, and thought geometry might aid analysis to find the proper starting-point. For a symmetrical curve he had shown that a point existed, starting from which the area traced by the hatchet end was zero. Dr. Macfarlane Gray thought Prof. Henrici's latter argument was vitiated by his figure not being correctly drawn; but this Prof. Henrici disputed. Mr. O. G. Jones said Prof. Henrici's construction was not obvious, for the cusp curves traced by the "hatchet" end depended on the starting-point. Mr. Yule suggested that by shortening the planimeter it might be possible to bring the third and second terms of Mr. Hill's formula into greater prominence, and, by going round the curve more than once, determine the first and second moments. —A paper on a new integrating apparatus, by Mr. A. Sharp, was taken as read. The paper describes an improved form of harmonic analyser, giving the amplitude and epoch of each constituent term, the mechanism of which is an inversion of that described in a communication made to the Society on April 13. Numerous drawings accompany the paper, showing the various parts in detail. The mechanism is also shown to be applicable for integraphs, and by suitable modification may be employed for mechanically integrating differential equations of various forms. A paper on magnetic shielding by a hollow cylinder, by Prof. Perry, and another on "Clark's cells," by Mr. S. Skinner, were postponed.

Geological Society, June 20.—Dr. Henry Woodward, F.R.S., President, in the chair.—On deep borings at Culford and Winkfield, with notes on those at Ware and Cheshunt, by W. Whitaker, F.R.S., and A. J. Jukes-Browne. Four borings at Culford, Winkfield, Ware, and Cheshunt were described in detail, so far as the specimens examined would permit; these were few in the case of Culford, but many from the other borings. The interest of the Culford boring centred in its striking the Palæozoic floor at the small depth of 637½ feet; but the age of the slaty rocks cannot be determined. Although only 20 miles east of Ely, no Jurassic rocks exist, and the Lower Cretaceous series is only about 32 feet thick, the beds differing greatly from those of Cambridgeshire, but resembling those of the same age in the Richmond boring. The Winkfield boring (3½ miles west-south-west of Windsor) was remarkable for having been successful in obtaining water from the Lower Greensand, and for the great depth (1243 feet) to which it was carried for this purpose, the Gault being unusually thick. The boring at Ware was for the first time described in detail, and former accounts were corrected from specimens preserved by the New River Company. By this means, and with the assistance of Mr. W. Hill, the authors were able to give a fairly complete account of the rocks, and to determine the limits of the divisions of the Upper Cretaceous series. They denied the existence of Lower Greensand at this locality. Of the boring at Cheshunt a complete account was given, based on information and specimens supplied by Mr. J. Francis, the engineer of the New River Company. The paper concluded with a tabular view of all the borings in the East of England, showing the level below ordnance datum at which the Palæozoic floor occurs in each. The President, Prof. Boyd Dawkins, Prof. Judd, and Mr. Topley spoke upon the subject of the paper, and Mr. Whitaker briefly replied.—The Bargate Beds of Surrey and their microscopic contents, by Frederick Chapman. This was an attempt to correlate the Bargate Beds of Guildford and its vicinity with the members of the Lower Greensand as known elsewhere in the south-east of England. Mr. T. Leighton, Prof. Judd, Mr. Whitaker, Dr. G. J. Hinde, Mr. Topley, and Prof. T. Rupert Jones offered some remarks upon the paper.—On deposits from snowdrifts, with special reference to the origin of the loess and the preservation of mammoth-remains, by Charles Davison. When the temperature is several degrees below freezing-point, snow recently fallen is fine and powdery, and is easily drifted by the wind. If a fall of snow has been preceded by dry frosty weather, the interstitial ice in the frozen ground is evaporated, and the dust so formed may be drifted with the snow and deposited in the same places. The snowdrifts as a rule are soon hardened by the action of the sun or wind, and the dust is thus imprisoned in the snow. As the snow decays, by melting and evaporation, a coating of dust is extruded on the surface of the drifts, and, increasing continually in thickness as the snow wastes away, is finally left upon the ground as a layer of mud, which coalesces with that of previous years. The deposit so formed is fine in texture, unstratified, and, as experiments show, mica-flakes included in it are inclined at all angles to the horizon. The author described several such deposits both in this country and in the Arctic regions; and suggested (1) that the loess is such a deposit from snowdrifts, chiefly formed when the climate was much colder, but still very slowly growing; (2) that mammoths suffocated in snowdrifts are subsequently embedded, and their remains preserved in the deposits from them; and (3) that the ground-ice formation of Alaska, &c., is the remains of heavy snowdrifts when the coating of earth attained a thickness greater than that which the summer heat can effectually penetrate. Mr. Davison's theory did not find much support. During the discussion upon it, Mr. Oldham said that he happened to have a personal acquaintance with the deposits left after the melting of snow and with the loess. The former were found in sheltered spots on the ridges of the Himalayas, which are annually covered with snow, but (so far as his experience went) they were denser and more compact than the true loess; they were, in fact, dried muds, while the true loess was a dust. In the hills of the western frontier of India, where loess was largely developed and still in course of formation, the distribution, surface-contour, and constitution showed it to be a wind-blown dust deposit, though it passed into deposits which had been rearranged by water. Part of this lay at altitudes where snow fell each year, but it was equally well and typically developed below the level at which snow usually fell, and where it was not preceded by a long frost nor lasted long enough to form extensive drifts. He did not think that the true loess could originate from the solid matter left by melting snow, and it could certainly be formed without the aid of snow. Prof. Blake, Prof. Boyd Dawkins, and Dr. W. F. Hume also spoke.—Additions to the fauna of the *Olenellust*-zone of the north-west Highlands, by B. N. Peach, F.R.S. New material obtained by the officers of the Geological Survey having been placed in the author's hands, he was enabled to add information concerning the species of *Olenellus* previously described by him (*O. Lapworthi*); he also described a new variety of this species, three new species of the genus, a new subgenus of *Olenellus*, and a form provisionally referred to *Bathynotus*. He discussed certain theoretical points based upon the study of the remains described in the paper, and stated that these make it probable that the dispersal of the Olenellids was from the Old World towards the New. Dr. Hicks and Dr. G. J. Hinde spoke upon the subject.—Questions relating to the formation of coal-seams, including a new theory of them: suggested by field and other observations made during the past decade on both sides of the Atlantic, by W. S. Gresley. A number of new facts were described, and the bearing of these and of previously recorded facts upon the origin of coal was discussed, special reference being made to the Pittsburgh coal. He maintained that the evidence pointed to the formation of coal on the floor of an expanse of water, by vegetable matter sinking down from floating "islands" of vegetation, which may have been of very large size, and enumerated cases of such "islands" or "rafts" of vegetation which have been described as existing in modern times.—Observations regarding the occurrence of anthracite generally with a new theory as to its origin, by the same author. After discussing Dr. J. J. Stevenson's theory of the origin of anthracite, the author described the nature and mode of occurrence of the anthracites of Pennsylvania, and gave his reasons for concluding that the de-bituminisation of coal was not produced by dynamic metamorphism during mountain-building, but rather by previously-applied hydrothermal action. He further discussed the applicability of his theory to other cases of anthracite, including that of South Wales and Ireland. In the discussion that followed, Prof. Boyd Dawkins pointed out that the anthracite-fields of South Wales and of Ireland are exactly in those places where the coal-seams have suffered most from crushing and faulting, and that therefore there is distinctly a connection between the exertion of dynamical force and the anthracitic condition. This also applies to the Irish fields. In some cases a coal-seam can be traced into an anthracite seam. In his opinion the author's views would not explain the presence of anthracite in this country.—The igneous rocks of the neighbourhood of Builth, by Henry Woods.—On the relations of some of the older fragmental rocks in north-west Caernarvonshire, by Prof. T. G. Bonney, F.R.S., and Miss Catherine A. Raisin. In a recent paper on the felsites and conglomerates between Bethesda and Llanllyfni, North Wales, it was argued that, in the well-known sections on either side of Llyn Padarn, a great unconformity separates the rocks into two totally distinct groups. The authors of the present communication discussed at the outset the great physical difficulties involved in this hypothesis; a subject which, in their opinion, was passed over too lightly by the author of that paper. They further affirmed, in the course of a description of the sections, which are most clear and afford the best evidence:—(1) That the strike in both the supposed rock-groups is generally similar. (2) That the same is true of the dips. (3) That very marked identity of lithological characters may be found in rocks on either side of the alleged unconformity, specimens occasionally being practically indistinguishable. (4) That in no case, which has been examined, can any valid evidence be found in favour of the alleged unconformity, and that in the one, which is supposed to to the most satisfactory proof of it, the facts are wholly opposed to this notion. Prof. Blake, Dr. Hicks, and Mr. Whitaker discussed these views, and Prof. Bonney replied.

Royal Microscopical Society, June 20.—Mr. A. W. Bennett in the chair—Dr. J. E. Talmage described his method for mounting and staining the brine shrimp, *Artemia fertilis*.—Dr. W. H. Dallinger called attention to a stereoscopic photomicrograph of injected muscle which had been presented by Dr. W. C. Borden.—Dr. Dallinger exhibited and described a new form of mechanical stage for the microscope, which had been produced by Messrs. Swift. Further remarks were made by the chairman, Messrs. Comber, Swift, More, and Beck.—Mr. J. H. Harvey described a method of mounting opaque objects so that they could be moved in all directions whilst under examination.—Mr. T. Comber read a paper on the unreliability of certain characters generally accepted for specific diagnosis in the Diatomaceæ. A discussion ensued, in which the chairman, Prof. F. J. Bell, and Mr. J. Badcock took part.—Prof. Bell gave a *résumé* of Mr. F. Chapman's sixth paper on the Foraminifera of the Gault of Folkestone.

Dublin.

Royal Dublin Society, June 20.—Dr. W. Frazer in the chair.—Dr. Telford Smith and Prof. D. J. Cunningham, F.R.S., gave a lantern demonstration of two microcephalic brains. One of these weighed 352 grammes; the other 559 grammes. The authors contrasted these specimens with the brains of the ape and the quadruped. The cerebrum in each had not passed in its development beyond the quadrupedal stage. The initial growth disturbance must therefore have occurred about the fourth month of fœtal development. With the aborted occipital region there was associated a marked convolutionary disturbance. The arrangement of the gyri and sulci did not correspond with that present at any period of fœtal life. It resembled the simian more than the human type; and what was most remarkable was the mixture of low-ape and high-ape characters. In some respects, therefore, the convolutionary pattern resembled that of a baboon, and in others that of a chimpanzee or an orang. The authors referred to the various theories which had been put forward to account for the condition, and upon the whole seemed to favour that of Karl Vogt, although the arguments they brought forward were of a totally different character. The results at which the authors have arrived will shortly appear in the Society's *Transactions*.

Paris.

Academy of Sciences, July 9.—M. Lœwy in the chair.—The death of M. Mallard, member of the Mineralogy Section, was announced.—On the photographs of the moon obtained with the great *coudé* equatorial of the Paris Observatory, by MM. Lœwy and Puiseux. (See our Astronomical Column.)—On some of the work done at Nice Observatory, by M. Perrotin. In connection with photographic exploration, the author observes that, in the sky regions examined, (1) the number of new asteroids (magnitudes 7–13) is much less than the number previously known; (2) only in the case of asteroids of the 13th magnitude are more now discovered than had been previously observed; (3) the total number of asteroids increases with decreasing magnitude as far as the 12th mag.—On new derivatives from benzoylbenzoic acid, by MM. A. Haller and A. Guyot.—Experimental production of the contagious peripneumonia of cattle by the aid of cultures. Demonstration of the specific character of *Pneumobacillus liquefaciens bovis*. Note by M. S. Arloing. The author concludes from his results quoted that (1) the virulent agent in contagious peripneumonia is an ordinary microbe, and (2) this microbe is the *Pneumobacillus liquefaciens bovis*.—Comparative researches on the products of the combustion of lighting-gas given by an Argand burner and an Auer burner, by M. N. Gréhant. The combustion products from the Auer burner yielded evidence of the presence of carbonic oxide to the extent of 1 in 2580, those from the Argand burner a trace only, estimated at 1 in 75,000.—Special images of the sun given by the simple rays corresponding to the dark lines of the solar spectrum, by M. H. Deslandres. The author gives the first results of a study of the surface layers of the sun by means of images formed by light from selected parts of the spectrum.—On the calorific radiations included in the luminous part of the spectrum, by M. Aymonnet. The following conclusions are deduced from a study of the spectra given by the Bourbouze and Drummond lamps and by the sun: (1) the eye does not perceive all the radiations between the red and violet; (2) the eye is not acted on by rays intercepted by water; (3) when the medium between the radiant source and the measuring apparatus contains water, there is an imperfect concordance between the distribution of heat and that of light in the same region of the spectrum; (4) the bright lines or bands which we can observe in a spectrum are only those or a part of those which pass through water.—On the polarisation of light diffused by roughened surfaces, by M. A. Lafay.—On the relation between the density of a saline solution and the molecular weight of the dissolved salt, by M. Georges Charpy. The density of a saline solution augments proportionally to the molecular concentration if it be admitted that the molecular weight of water at 0° is about 3 × 18. The densities of equally concentrated solutions of analogous salts are nearly proportional to their molecular weights.—On a new glucosane, lævoglucosane, by M. Tanret.—Syntheses by means of cyanacetic ether. Phenylcyanacetic ethers, by M. T. Klobb.—On paraphthalodicyanacetic ether, by M. J. Locher.—On pine tar, by M. Adolphe Renard.—The quantitative composition of creosotes from beech and oak, by MM. A. Béhal and E. Choay. Beechwood creosote is richer in guaiacol than that from oak.—Inuring ferments to antiseptics and the influence of this hardening on their chemical work, by M. J. Effront.—The nature of onychomycosis, demonstrated by culture and by inoculations, by M. J. Sabrazès.—On the coexistence of the sternum with the shoulder-girdle and lungs, by M. Alexis Julien. The sternum varies in its composition, form, and texture, in its development and even in its connections. Notwithstanding this great variability, certain constant features may be distinguished. The sternum always coexists with the shoulder-girdle and lungs, that is to say, all vertebrates which have a sternum have also lungs and shoulder-girdles, but the converse is not true.—On the insertion of the membrane of Corti, by MM. Coÿne and Canniew.—On the topography of the attached urethra, studied on sections of frozen subjects, by M. L. Testut.—On the measurement of the absorption of water by roots, by M. Henri Lecomte.—On the petrographic nature of the summit of Mont Blanc and the neighbouring rocks, by MM. J. Vallot and L. Duparc.

Berlin.

Physical Society, June 1.—Prof. du Bois Reymond, President, in the chair.—Prof. König described a repetition of H. Müller's experiments on the part of the retina in which the sensation of light takes its origin, using, however, monochromatic light. Müller, as is well known, had localised it in the rods and cones by observing that the shadows cast by the blood-vessels of the retina execute movements, when the source of light is moved (Purkinje's experiment), which correspond to the distance between the blood-vessels and the layer of rods and cones. Prof. König had repeated the measurements on the normal eye of Dr. Zumft, whose constants he had accurately determined, using four kinds of monochromatic light, namely, that of the lithium line in the red, of the D sodium line, of the thallium line, and of the line F. He found as a result of fifteen separate determinations that the distance of the light-perceiving elements of the retina from the blood-vessels which give the shadows varies with the varying wave-lengths of the different lights, a result which can only be explained on the basis of Young's theory of colour-vision.—Dr. H. du Bois spoke on the changes of resistance of a bismuth spiral in a powerful magnetic field. This change, discovered by Lord Kelvin, had been measured in the case of bismuth in a magnetic field whose maximum strength was 12,000 C.G.S., and the curve of resistance in the field, compared with that of the resistance outside the field, was found to be at first concave upwards and then straight. The resistance in the field of maximum strength was 1·7 of that in zero field. The speaker, using some very powerful electromagnets which he had recently exhibited to the Society, and which gave an intensity of 38,000 C.G.S., had, in conjunction with Dr. Henderson, measured the resistance of spirals of pure bismuth, and found that the curve pursues a further straight-line course, so that the resistance in the field of greatest intensity is three times as great as in a field of zero intensity. The measurement of the resistances in a magnetic field at different temperatures had yielded interesting results. In weak fields a rise of temperature increased the resistance: in stronger fields the effect was less, and became zero in a field of 7000 C.G.S. In still stronger fields the resistance of the warm spiral was less than that of the cold. The experiments have so far been carried on only for temperatures between 0° and 25°, but will be pushed further up to 100°.—Dr. Pringsheim described an ingenious procedure by means of which he had succeeded in obtaining positives of old manuscripts on which old and faint characters were obscured by newer and dark writing. The positives were obtained by a combination of several photographs, and showed only the older and fainter characters in sharp and clear definition.

June 15.—Prof. von Helmholtz, President, in the chair.—Prof. von Bezold gave an address in memory of Prof. A. Kundt, the Vice-President of the Society, recently deceased, in which he dwelt upon his scientific labours, and in particular upon his distinguished efforts as a teacher.

New South Wales.

Royal Society, May 2.—Prof. Anderson Stuart delivered the presidential address. He gave a detailed account of the poison of *Ornithorhynchus paradoxus* and of the poison of the "Bush-tick," and alluded to that of the Australian varieties of the spider-genus *Lathrodectus*. After describing the present favourable state of the arrangements for an expedition to one of the South Sea atolls, to realise the suggestion of Darwin to bore and bring up a core, and thus probably settle the question of the origin of the atoll, he announced that, acting on behalf of the Committee of the British Association, he had secured the loan of a diamond drill from the Government of New South Wales. He also spoke of the artesian water supply of the colony in reference to the probable limits of its supply, and favoured the naming after Darwin of some place in the Blue Mountains associated with Darwin's visit. He then reviewed certain questions of present importance in the colony, such as the disposal of sewage, the characters of sewer-air, and the backward condition of sanitary legislation in the colony, &c. The Society is maintaining its position very well, in spite of the present extremely adverse circumstances of the colonies. The officers and council were elected for the ensuing year, Prof. R. Threlfall being President.

Linnean Society, May 30.—Prof. David, President, in the chair.—Notes on the methods of fertilisation of the *Goodeniaceæ*, by Alex. G. Hamilton. Three species of *Scævola*, one of *Selliera*, and one of *Brunonia* were dealt with. The writer concluded that although there is an elaborate contrivance in the first four for securing cross-fertilisation by the aid of insects—which was described in detail—yet, if that fails, self-fertilisation occurs. *Brunonia* was said to be anomalous in its methods. The process of fertilisation in the three allied orders—*Lobeliaceæ, Goodeniaceæ*, and *Campanulaceæ*—was contrasted, and it was shown that the same end is secured by widely different adaptations of the same organs.—On three highly ornate boomerangs from the Bulloo River, N.S.W., by R. Etheridge, junr.—Note on the tertiary fossils from Hall Sound, New Guinea, by Prof. Ralph Tate. The author's observations were based on an examination of the specimens in the Macleay Museum, obtained during the voyage of the *Chevert*. These were reported on by the late Rev. J. E. Tenison-Woods (*P.L.S.*, N.S.W. 1878, ii. (2), pp. 125 and 267), who referred them "to a very recent tertiary formation, much newer than any of the Murray River or Western Victorian beds." The author concurred in this view, but pressed for a more recent origin than that implied by Tenison-Woods—even Pleistocene. Some critical observations on the specific determination of the specimens were given—a matter of some difficulty in most cases by reason of their imperfect condition.—On the morphology of the muscles of the shoulder-girdle in monotremes, by W. J. Stewart McKay. The author has found a clavicular deltoid present in both *Echidna* and *Ornithorhynchus;* also a pectoralis quartus, teres minor and subclavius. The teres major is single in both forms; the sub-scapularis of great extent. Much attention has been given to the nervous system, and elaborate dissections have been made to trace out "the latent cutaneous nerve of the thorax" (Patterson) and its communication with the intercostal nerves.—Description of a new Australian snake by J. Douglas Ogilby. The habitat of the new species (*Hoplocephalus waitii*), which differs mainly from *H. pallidiceps*, Günth., in having 21 series of scales round the body instead of only 15, appears to be the central district of N.S.W., whereas *H. pallidiceps* is a North Queensland form.—Fishes new or rare on the Australian coasts. By Edgar R. Waite. The fishes dealt with were from Maroubra, N.S.W., and are either new to Australia or of exceedingly rare occurrence, and with two exceptions obtained for the first time on the coasts of this colony. The species mentioned are:—*Dules argenteus*, Bennett, *Acanthurus triostegus*, Linn., *Psenes whiteleggii*, sp. nov., *Nomeus gronovii*, Gmel., *Schedophilus maculatus*, Günth., *Glyphidodon brownriggii*, Bennett, *Solenognathus hardwickii*, Gray, *S. spinosissimus*, Günth., *Monacanthus filicauda*, Günth., *M. nitens*, Hollard, and *Leptocephalus*. The author expressed the opinion that *Solenognathus fasciatus*, Günth., is not specifically distinct from *S. spinosissimus*.—Description of a new mite belonging to the genus *Heteropus* found in wasps' nests, by W. W. Froggatt. The name *Heteropus alastori* was proposed for a mite which has been found in great numbers in the clay nests of the solitary wasp, *Alastor eriurgus*, Sauss., in the neighbourhood of Sydney. The gravid female has an immense globular abdomen eight times the length of the head and thorax combined.—On the mode of attachment of the leaves or fronds to the caudex in *Glossopteris*, with remarks on the relation of the genus to its allies, by R. Etheridge, jun., with note on the stratigraphical distribution of *Glossopteris* in Australasia, by Prof. T. W. Edgeworth David. The fossil plant *Glossopteris*, which formed the predominant type of swamp vegetation in Eastern Australia during the Permo-Carboniferous Period, when the productive coal-measures were being formed, has left records of its former presence almost invariably in the form of leaves only. Only two authentic cases have been recorded of *Glossopteris* leaves having ever been found attached to any kind of stem, previous to the discovery of the specimen found near Mudgee by Mr. J. C. McTaggart, which makes the third specimen ever discovered, and which was described by the authors. The specimen shows that some variety, at all events, of *Glossopteris* in Australia had somewhat the form of a dwarf tree-fern, with a caudex, or stem, at least six inches in length, and surmounted by a clump of closely packed fronds to the number of about eight. The fronds, as proved by the scars on the caudex, were not placed on a verticil, but spirally on the caudex. They are sessile, not petiolate as in the case of the specimen described by Prof. Dana from Illawarra.—Mr. Hedley read the following note:—"From the throat of a *Rallus pectoralis* Mr. J. A. Thorpe of the Australian Museum extracted the snail I now exhibit. This is a specimen of *Chloritis jervisensis*, Quoy and Gaimard, a species common in this neighbourhood, whose almost adult and uninjured shell measures 18 mm. in diameter, and which weighed, shell and animal together, 1·26 grammes. When found by Mr. Thorpe, to whom I am indebted for both facts and specimen, the snail was quite dead; as a test I immersed the animal in strong spirits without inducing contraction; since, however, its consumer had been killed forty hours earlier, the suffocation of the mollusc was to be expected. The bird was shot at Randwick, near Sydney, on May 19, 1894, by Mr. Newcombe, Deputy Registrar-General. In enumerating 'Means of Dispersal,' Darwin observes ('Origin of Species,' 6th ed. p. 372): 'A bird in this interval [eighteen hours] might easily be blown to the distance of 500 miles, and hawks are known to look out for tired birds, and the contents of their torn crops might thus readily get scattered.' In view of the above incident, this suggests a means whereby the geographical range of *jervisensis* might be considerably extended."

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